TIME STUDIES CHRONOMETER WITH GENERIC DESCRIPTIONS

[01] This application claims priority from U.S. Provisional Application 60/270,137 filed February 20, 2001.

Background

[02] A time study (time and motion study) is a procedure used to determine the time it takes a person to do a specified series of tasks with a specific quality. A time study is used to determine the most effective ways for an organization to use the basic factors of production, people, machines, materials, information, and energy to make or process a product or produce a service. Examples include:

Measurement for operations:

- Routing sheets
- Floor layouts
- Material handling
- Machine utilization studies
- Development and maintenance of labor standards

Development and application of appropriate production standards for:

- Manufacturing operations
- Design
- Implementation
- Maintenance of incentive programs
- Operational efficiencies
- Cost reduction programs

Development of databases to assess and optimize:

- Human Factors
- Efficiency
- Safety

Evaluation of opportunities for performance improvement:

- Quantify potential cost savings opportunities
- Help implement cost effective programs

Increase productivity and efficiency while reducing costs

[03] The first industry recognized time study used for process improvement was in 1878 by Fredrick Taylor in a steel mill in Philadelphia. Tools used for that study were a stopwatch and paper. At that time, the techniques required hand entry of observed elements; hand transferring of timed results, and a manual analysis of the data. That was over 122 years ago. This time study method of stopwatch and paper remains the industry standard today, with the exception that the data may now be analyzed by computer.

[04] Time studies require measuring the duration of each task in a series of tasks, writing a description of the task to identify it, and writing down a time duration for each task. Sometimes notes or characterizations must be made about a task. The data is then transferred to data analysis sheets or a computer for analysis and presentation. Time spent recording a description of the task, noting a characterization of the task, and recording time is time not spent observing. Large amounts of time are required to enter task descriptions and characterizations, transfer the data to a computer or sheets of paper, and generate useful reports. Also, time amounts for similar tasks or otherwise related tasks are not grouped together for analysis, so this must be done by a person specifying the groupings. In other words, there are few tags or meta-data that describe the data.

Summary of the Invention

[05] The invented system greatly reduces time required for setup, data collection, and building reports the most time consuming, error-ridden and expensive part of traditional time studies. It also adds computer-usable tags to the data to facilitate further analysis.

[06] The invented time studies chronometer preferably comprises a portable, handheld computer with a touch screen programmed to be a continuously running chronometer with a plurality of alternative generic task description options and one or more generic characterization options for each task. The computer captures data files which store the timed interval of each task. The task description options are preferably buttons or icons on the touch screen that generically describe a task. The chronometer times the specific task or tasks as the time from one mark time button press at a transition between tasks to the next mark time button press at a transition between tasks. The clock continuously runs for the duration of the study.

[07] The gathering of observed data is preferably accomplished through the use of easily identifiable, on-screen task description icons on a handheld touch screen PC designed for use in an industrial environment. These icons are specifically tailored to include all relevant and observed elements in the time study process. The touch screen icons are immediately recognizable, enabling quick association with the observed elements and can be more immediately recorded by the observer. With the invented system, the duration of an element that can be recorded accurately is 1.5 seconds, which is enough time for an observer to select a task description icon, select a characterization icon for the task, and press the mark time button.

[08] The characterization options are preferably implemented by giving the user a choice of icons that represent possible characterizations. When an icon is pressed on the touch screen, it assigns the characterization that it represents to the task currently being timed. The apparatus might include characterization options to identify any generic characterization or quality of a task. The characterization most commonly desired is "value added" or "non-value added". However, any characterization can be associated with any task, such as the inspection method used to verify successful completion of the task.

[09] By using on-screen generic icons that are easily identifiable and manipulated when used with a handheld touch screen PC to identify tasks and characterize tasks, less time is required to input the observed information. This in turn, means more time is spent observing the subject. Also, no time is spent making a list of the tasks to be studied before the study is commenced. The list is generated on the fly. Even though the icons are carefully selected to represent all likely tasks to be encountered in a manufacturing facility, an "Unknown Element" icon can be pressed if an unrepresented task is observed, and an appropriate description can be entered later for the task using the keyboard or other input method.

[10] By presenting the user with many optional generic task descriptions, two important objectives are achieved. Time is saved for the observer, as mentioned above, and data analysis can be automated. A single generic description icon is used for many tasks, allowing automated processing of data from tasks by using the description as a tag or meta-data. Similarly, by offering the user a choice among generic characterizations for a task, characterizations can be used as a tag or meta-data to allow analyses of tasks that share the same generic description.

[11] To allow analysis of data at a second level, series of tasks that are performed one after another are functionally grouped into "processes" or "task series" and each process is given a description by selecting among generic pre-specified descriptions for the process or series of tasks. Consequently, time data is automatically captured for the process, from beginning to end, and processes which have the same generic description are automatically grouped together for potential subsequent processing.

[12] Similarly, each time study is given a generic description by the user selecting one of many generic descriptions so that, as data is collected from many time studies, the data from similarly described time studies is automatically grouped for subsequent processing or analysis.

[13] In one aspect, the invention is a time studies chronometer with a changeable display which presents to a user a plurality of generic task description options for each observed task and accepts input from a user to select one of the task description options for the task. In another aspect, the invention is software for a computer, that is, a data carrier containing a computer program which, when run on a general purpose computer, causes the computer to be the chronometer just described. The data carrier may be a memory device, such as a disk or memory chip or any other physical portable memory, or it may be an electronic signal such as transmitted over a computer network. The set of generic task descriptions are typically loaded into the memory of the chronometer by copying from an external memory, such as a disk, coupled to the chronometer for uploading the option descriptions.

[14] In another aspect, the invention is a time studies chronometer (or computer software therefore) that presents on a display generic task rating or characterization options to characterize a task and accepts input from a user to select one of the task characterization options. Preferably, the options are presented on the display with one or more icons on a touch screen. Such a characterization (rating value) might be "value added" or "no value added". Another characterization might be a method of inspection used to verify that a task was completed successfully and the generic characterizations might be "sight", "touch", or "device" (if a device is used for the inspection method, such as an electrical continuity tester).

[15] In another aspect, the invention is a time studies chronometer (or software therefore) with a changeable display that collects data for tasks where the tasks are organized into task series so that the data can be analyzed at both the task level and the series level. That is, for a task series to be observed as part of a time study, the display presents task series description

options to describe the task series and, upon receipt of input from a user selecting a task series, the display presents task description options to describe a task and the chronometer then accepts input from a user to select one of the task description options for the task. In this aspect of the invention, the descriptions need not be generic but might instead have been to specifically describe the tasks and processes to be studied.

[16] The two levels of data just described may be further embedded in a third level of data at the time study level by, before presenting a plurality of task series description options to a user, the display presents a plurality of study description options to describe the study to be done and the chronometer accepts input form a user to select one of the study description options.

[17] It has become common within industry, in particular to meet ISO 9000 requirements, to print and display a worksheet document containing work instructions for a task to be done. The worksheet includes standard text which is the same for all worksheets, a task name, a task description, and a typical time duration for the task. In another aspect, the invention is a method for generating such a worksheet by setting up the standard text for each worksheet, receiving a task name and description for a task, receiving a marked time event designating commencement of the task and then a marked time event designating finish of the task, storing in a memory the task name and description and, associated with the name and description, time data indicating duration of the task, and then generating data representing a worksheet document for the task comprising the standard text, the task name and description, and duration of the task.

[18] If a task characterization was collected during the time study noting the inspection method used with the task, the inspection method can also be automatically added to the worksheet document. Further, the worksheet document can be set up to receive digital photographic data so that when the document is displayed or printed, a photograph of how to perform the task is included.

Brief Description of the Figures

[19] Figures 1 – 7 show screen displays generated by the system during the process of collecting data of a time study.

[20] Figures 8 and 9 show two reports automatically generated by the system.

Detailed Description

[21] The invented system can be implemented with any general purpose computer. Preferably, it is implemented with a hand held computer with a touch screen for both output and input. The same hand-held touch screen computer can be used in a variety of industrial, office or home environments with the use of appropriate software for each study. An effective operating system for the computer is Microsoft Windows CE®. Suitable hardware includes but is not limited to any one of the following, Fujitsu PenCentra®, HP Jornada ®, NEC MobilePro 78®, Two Technologies TouchLite® and Hitachi ePlate ®. In a factory where the time studies observer (analyst) can see operations from a desk chair, such as with video cameras, the system can be implemented with a desktop PC and a mouse for input. Timer data collection is merely to the nearest second, which presents no problems for ordinary operating systems on hand held or other personal computers.

[22] A time studies application software module provides the generic task description icons for the types of tasks to be studied, as well as appropriate characterization icons, process description icons, and study description icons. For example, different modules would apply to the following industries: manufacturing, assembly, transport / delivery, traffic monitoring (a generic description of each vehicle can be captured along with a time stamp), garment, food processing, warehousing, time management / billing, customer service, and hospitality / cruise industries.

[23] After the data is gathered, it is analyzed and compiled by an analysis module that is run by either the hand held itself or run on a desktop or laptop PC to which the data is transferred. In either case, a fully compiled, set of forms, graphs, and charts is automatically generated using the meta-data provided by the generic task descriptions, task characterizations, process descriptions, and study descriptions. They are automatically ready for presentation on paper or screen. See Figures 8 and 9.

[24] The process of performing a time study with the system works as follows. After starting the time study program, the observer conducting the time study (analyst) first inputs the necessary information to accurately identify the study as shown in Figure 1. The display then presents the image shown in Figure 2. Next, he selects, from a plurality of presented options for study categories (generic study descriptions), each represented by an icon **2**, as shown in

Figure 2. The study descriptions shown in Figure 2 include words as well as icons. Alternatively, only words or only icons could be used.

[25] The display then presents the image shown in Figure 3. Next, when the person performing the tasks starts the process, he starts a timer (run by software that checks the clock in the computer) by selecting a presented start icon **4**, as shown in Figure 3, and observes the person (subject) performing the tasks. The display then presents a set of optional generic task series (process) descriptions in the form of icons **6** as shown in Figure 4. The task series descriptions shown in Figure 4 include words as well as icons. Alternatively, only words or only icons could be used.

[26] Once the observer discerns what the subject is doing, he selects one of the icons **6** describing a process containing the group of tasks and/or subtasks (series of tasks) that he is observing. The display then presents a set of optional generic task descriptions in the form of icons **8** as shown in Figure 5. The task descriptions shown in Figure 5 include words as well as icons. Alternatively, only words or only icons could be used.

[27] The observer selects the appropriate task icon to describe the first task. The display then presents a set of task characterization options in the form of icons **10** as shown in Figure 6 which, in the example shown in Figure 6, characterize the task as value adding or non-value adding. The task characterizations shown in Figure 6 include words as well as icons. Alternatively, only words or only icons could be used.

[28] Then the observer presses a task characterization icon that causes data for the first task to include the characterization. Next, if the embodiment is equipped with an additional characterization option, the observer records an additional characterization of the task. For example he may characterize a method of inspection used to verify that the task was completed properly as "sight" ("visual"), "touch", or "device" ("instrument").

[29] The display then presents a mark time button **12** as shown in Figure 7. Finally, upon finish of the first task and commencement of a new task, the observer presses the mark time button to stop timing the first task and start timing the next task.

[30] The display again presents the set of optional generic task descriptions in the form of icons **8** shown in Figure 5 so the observer can select an icon to describe the new task. If the user has finished the process (series of tasks) and begun the first task of a new process, the

observer presses a "back" / "up" button **14** (labeled "Process" in Figure 5 and labeled "Back" **15** in other figures) to return to the process selection screen shown in Figure 4. Even if the newly started process would use the same generic task series description as the prior process, it is important for the observer to return to the screen of Figure 4 and reselect the same process icon so the time studies chronometer can capture timing data to mark the end of the prior process and commencement of the next process (of the same generic description).

[31] Whenever the study should be ended and the study timer stopped, the observer presses any one of the stop study buttons **16** as shown in Figures 4 – 7. The display then returns to Figure 1. The study data is saved as a file in a file system on the chronometer. If the observer wishes to recommence the study, the data file can be opened using the File tab **18** shown in Figure 1 and the next screen presented is then Figure 3.

[32] It is important to note that the above description of the levels of organization in the data collected are not intended to limit other possible organizational arrangements, rather it is merely illustrative of one particular embodiment.

[33] Some time study methods use a narrow definition of a task. Some tasks that might not be included within a narrow definition are listed in Table 1 below. Inclusion of these tasks improves the quality of the data captured by the time study.

TABLE 1

Task Name	**Description**
Talk	Communication with one or more.
Walk	Walking without carrying materials.
Running	Running.
Search	To randomly look.
Observe-Stare	Determining next task or sequence
Waiting	Pause, halt or delay an activity or task.

Paperwork	Starting or completing forms, drawings, data gathering or any computer work.
Personal	Non-planed activity such as going to the bathroom, phone call or smoke break.
Break	Planned work stoppage.
Lunch	Planned eating time.
Unknown element	Unable to identify or categorize element or elements

[34] The last task listed above is required in this system because all of the tasks that are pre-specified in the system are generic. That is, they would be suitable descriptors for many specific tasks that are conducted in a typical process of the type to be studied. If the worker (or object of study) begins a task or process that does not have a pre-specified generic description, the observer can specify "unknown element" as the task or process. While the task is being conducted or after the task is completed, the observer can enter a textual description of the task. In a preferred embodiment, there is a "notes" field that can be activated pressing the note button **13** in Figures 5 - 7 in which the observer can enter any notes associated with any task. A task description for an unknown task can be entered in the notes field while the task is being performed.

[35] A consequence of using "unknown element" to describe a task or process is that the data for this task or process cannot be automatically grouped by the system with other data for similar tasks or processes. If such grouping is appropriate, the observer must do it manually. Alternatively, after the task or process has been completed, the observer can edit the time study data file by selecting the edit command **19** shown in Figure 1 to then select one of the generic task or process descriptions for the task or process. As another alternative, if the observer has used the "unknown element" generic description to identify more than one task or process and these are all similar to each other, the observer can create a new name, a new description, and even select from standard icons an icon to go with the task or process for future use. The data for the newly defined generic task or process is now grouped by the task or process name for further automatic processing together.

[36] If the observer makes an error in a process, there is no way to "undo" the selection of a process because that step started a timer. Likewise, selection of a task starts a timer and cannot be "undone" until the study is completed. The observer simply notes the error in the notes field and then corrects the error by editing the time study data file as necessary.

[37] Once a user has obtained a computer program for running on a general purpose hand held touch screen computer, the user will want sets of generic study descriptions, process descriptions, task descriptions, and task characterizations for use with particular types of processes of interest to the user. It is anticipated that venders will offer digital data sets containing these description options for copying by the user into the user's time studies chronometer.

[38] In a preferred embodiment, the software is organized with a primary module that can be run in more than one instance at a time under the selected operating system. A user interface facility is provided to make it easy for the user to launch a second instance of the time study module, which presents a second window, from within the first window display presented by the first instance. By this method, multiple time studies can be conducted at once. For example, where a single observer is observing two different workers, if the workers are not changing tasks too frequently (more frequently than approximately once every four seconds), the observer can switch between the instances to record data for both time studies at once because the use of icons allows the data to be recorded so rapidly. Consequently, the invented system makes it practical for a single observer to conduct two or more time studies at one time.

[39] For running two time studies at once, once the first instance is operational, either before or after the timer has been commenced for the first study, the user instructs the chronometer to commence a second time study which then presents the information for a second study in a second window on the display. Typically, each window will occupy most of the display and the user will have to tap a portion of the display that is not occupied to reveal the window that is hidden. The program keeps track of which time study each item of user input should be entered into by simply entering it into the study where the window is displayed that presents the button selected by the user.

[40] Once the time study is completed, the second major component of the invented system comes to the fore. This component automatically generates reports and analyses using the data that has been collected. It takes advantage of the meta-data created by virtue of the fact

that the user selected from pre-specified generic descriptions for the study description, each process description, each task description, and each task characterization. The reports that can be generated are: flow chart, sequence, summary, process, non-value added, projected choke point, average time per task, and work instruction.

[41] Figure 8 shows a typical report that takes advantage of the meta-data to achieve automatic computations. This report shows the total time for each of four processes within the study, drilling **21**, welding **22**, clamping **23**, and cleaning **24**. Two of the processes include non-value added tasks and the time for each of these two processes is broken into value added and non-value added portions. These computations could be performed automatically because, for example in clamping, all of the clamping processes had the same process description, allowing the computer to use the process description to select the process times for each of the clamping processes to compute a total.

[42] Similarly, the system uses the value added or non-value added characterization to break the total time for each process into two parts, as shown in Figure 8, or add a total of value added or non-value added times.

[43] In addition to simple automatic addition and presentation processing as shown in Figure 8, the system can use the meta-data to select time durations for tasks or processes or studies having a common description to then compute range of values, distribution of values, standard deviation of values, mean (average), or the median.

[44] Figure 9 shows another type of report that is particularly useful. By taking advantage of the fact that, for each task, the system now has a task name and description as well as a duration (which might be automatically computed as a mean of observed durations or a median of observed durations or a duration computed using standard deviation methods), all that is required to generate a set of work instructions on a worksheet is to add standard text which is the same for each worksheet and formatting. Consequently, a preferred embodiment of the invented system includes the standard text and formatting and can automatically generate worksheet documents containing work instructions which can be displayed on a display or printed. This is particularly advantageous for companies that seek ISO 9000 certification for manufacturing processes because such certification requires such a work instructions document for many tasks.

[45] A typical work instructions worksheet document generated by the system is shown in Figure 9, including the standard text **30**. In a preferred embodiment, the document includes a space **31** for inserting a digital photograph or drawing of the task being performed, as shown in Figure 9, or a detail of the work piece. The inspection method key **32** in Figure 9 shows visual codes used to indicate whether the proper inspection method is visual, by touch, or by instrument (device). One of the visual codes **33** is automatically placed beside the picture or drawing as shown in Figure 9 based on characterizations observed by the time study analyst.

[46] While details of particular embodiments of the invention have been described, the elements of the invention are not to be defined by such embodiments but rather only by the following claims.